INTERNATIONAL ISSUE

# telephony

JUNE 27, 1983

THE JOURNAL OF TELECOMMUNICATIONS SINCE 1901

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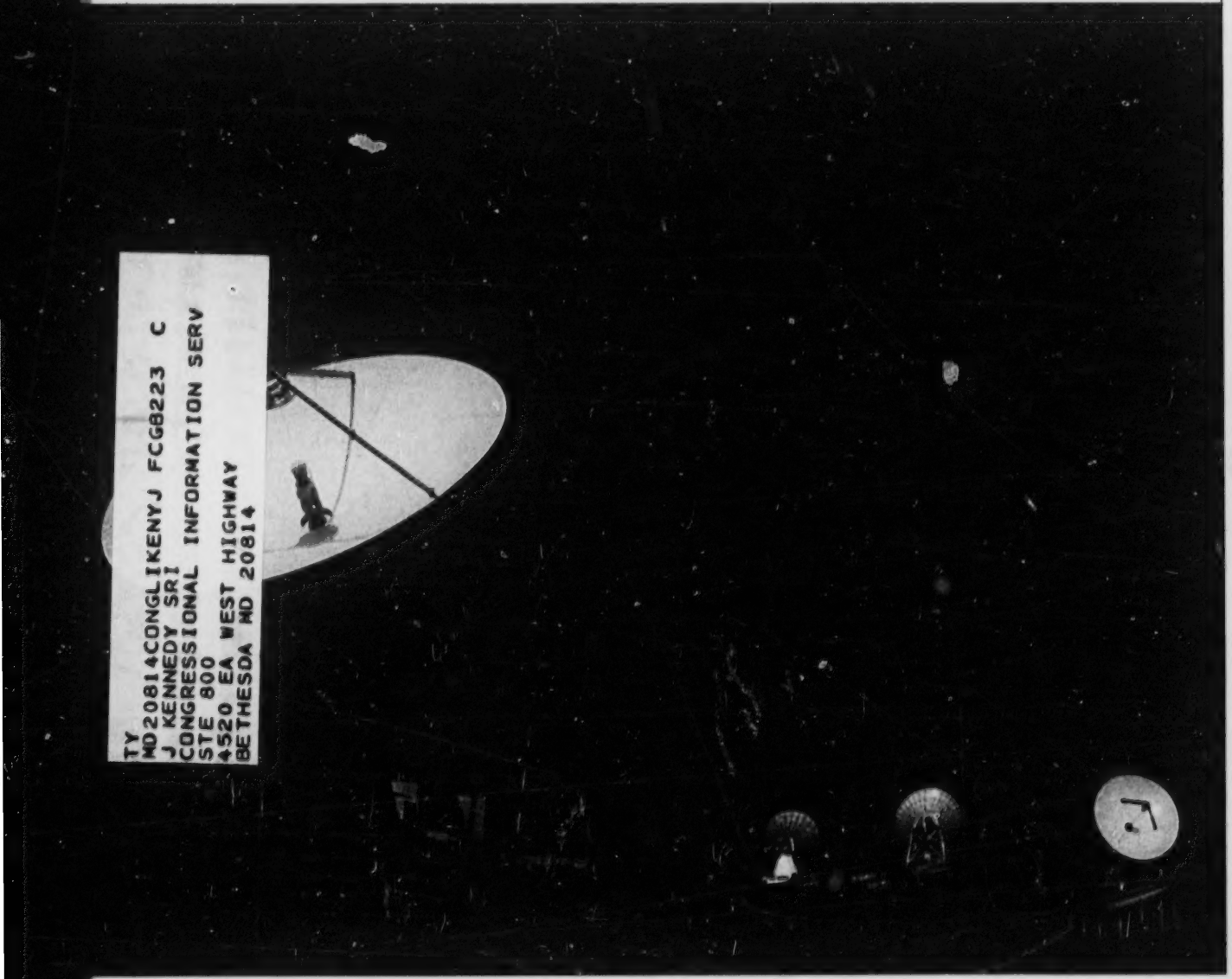

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**Published by TELEPHONY PUBLISHING CORP., 55 E. Jackson, Chicago, IL 60604 Telephone 312/922-2435; TWX 910 221 1058**

**European Bureau, 136 Broomfield Rd., Chelmsford, Essex CM1 1RN, England; Telephone Chelmsford (0245) 58257; Telex 995801 GLOTLX-G.**

**TELEPHONY (ISSN 0040-2656/83-0+$1.50)** is published weekly (except twice weekly during the second week of August and three times during the month of December) by Telephony Publishing Corp. Officers of Telephony Publishing Corp. are Dan S. Fargo, President; Leo Anderson, Executive Vice President; Del Myers, Ed Robinson and Robert Wehofer, Vice Presidents. Postmaster: Please send form 3579 to Subscription Dept., TELEPHONY, 55 E. Jackson Blvd., Chicago, IL 60604. Second class postage paid at Chicago, Ill., and at additional mailing offices. Single copies (payable in advance) U.S. $3.00 ea., issues over 2 years old $3.50 ea. Outside U.S. add $1.00 ea. Subscriptions: $29 one year. Outside U.S. add $20 per year. Subscription rates apply to employes of operating telephone companies; telephone consultants; contractors; interconnect companies; specialized common carriers; military government associations; private communications users; schools, libraries. All others $35 one year. Outside U.S. add $20 per year. Change of address: include old address as well as new address. Attach issue label if possible. Allow 4 weeks for change to become effective. Copyright 1983 by Telephony Publishing Corp. Permission to photocopy for internal or personal use or the internal or personal use of specific clients is granted by Telephony Publishing Corp. for libraries and other users registered with the Copyright Clearance Center (CCC) provided that the fee of $1.50 per page is paid directly to CCC, 21 Congress St., Salem, MA 01970. Special requests should be addressed to Telephony Publishing Corp.

# Telecommunications is expanding this gateway to China

Hong Kong has become a major hub of international communications. Here is a close-up view of the company which connects Southeast Asia with the rest of the world

PETER FORESTAL

HONG KONG'S NAME is derived from the Chinese words for "fragrant harbor." Its natural deep water harbor at the estuary of the Pearl River has brought prosperity to Hong Kong.

Hong Kong became a British colony in 1842 and by 1873 John Pender, a wealthy English businessman and founder of submarine telegraph companies, had formed the Eastern Extension Australasia and China Telegraph Co., which linked Hong Kong by submarine telegraph cable to Madras, Darwin, Singapore, Saigon and Shanghai. This company was the grandparent company of Cable and Wireless (Hong Kong) Ltd. (CWHK), and even today the Cantonese name for CWHK is Dai Dung Din Bo Ko, or Great Eastern Telegraph Bureau.

In the 141 years since Hong Kong became a colony, it has become the third largest container port in the world and the third largest gold dealing center in the world. The population is now 5.5 million.

CWHK provides all the international telecommunications and some internal services for Hong Kong. CWHK now has direct links with 46 countries and has become a major transit center for telephone, telex and data traffic in Southeast Asia.

The company was established as a separate entity from the London office on Oct. 1, 1981. Currently, 20% of the shares are held by the Hong Kong government and 80% are held by Cable and Wireless plc (CWPLC) of the U.K.

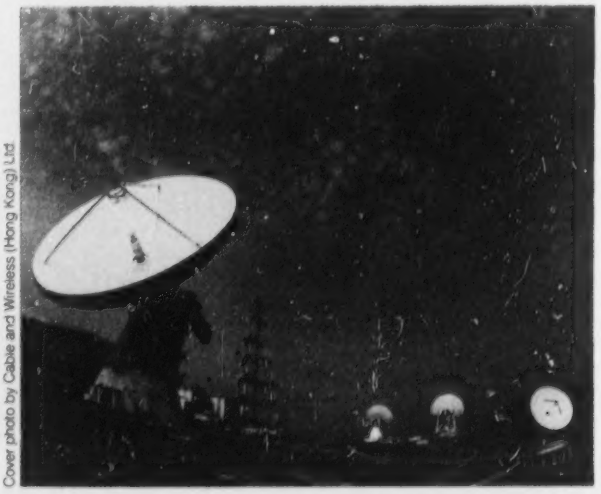
The executive committee headed by Managing Director Brian Pemberton reports to the board of directors. There are five general managers and a senior general manager on the committee. There are six business functions in CWHK, each one headed by one of the general managers on the executive committee. They are personnel and administration, local engineering, international engineering, telecommunications services and marketing, and finance.

The continuous expansion of telecommunications in Hong Kong caused the company to outgrow its offices in Mercury House, on Hong Kong Island. A 21-story building, named New Mercury House, was built on land reclaimed from the harbor in 1972, and was officially opened in January 1973.

Further expansion resulted in construction of another telecommunications center on the mainland. A new 12-story building, Hermes House in Kowloon, was completed in 1981, across the harbor from New Mercury House. Hermes House will provide for even diversification of both telephone and telex facilities, and allow for restoration if an accident damages one of the facilities in either building. The telex service already has been fully diversified. Telephone service diversification will be completed in November.

As part of the expansion program, the acquisition last March by Cable and Wireless plc of the 34.8% controlling interest in Hong Kong Telephone Co. will provide an increasingly close cooperation between Cable and Wireless and Hong Kong Telephone Co. This will enable Hong Kong to continue to strengthen its position as one of the world's major communications centers. Hong Kong Telephone Co. has more than 2 million telephones installed. In January 1982, 64.1% of international outgoing calls were subscriber dialed. All urban and interurban telephone calls are free. Hong Kong Telephone Co. is increasing the local line capacity by the use of optical fiber cables and pulse code modulation (PCM).

CWHK currently has more than 2700 employes. The company runs a technical and operating school with instructors who can speak Mandarin, Cantonese and English. About 12 basic technician courses are con-



Cover photo by Cable and Wireless (Hong Kong) Ltd.

*The four CWHK satellite dishes located at Stanley, Hong Kong.*

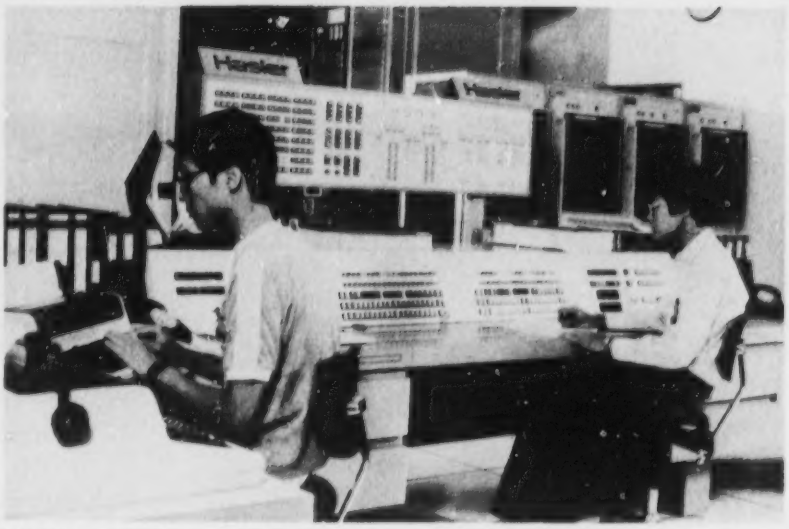
*Peter Forestal* is General Manager International Engineering at Cable and Wireless (Hong Kong) Ltd., Hong Kong.

ducted each year. In 1981-82, 440 staff members participated in a variety of in-house training programs.

The company's Local Engineering group deals with the technical areas within Hong Kong, which include more than solely telecommunications. The group handles:

- Installation and maintenance of radar, navigational aids and various telecommunications facilities associated with the Hong Kong International Airport.
- Engineering services and studio control for the government-owned Radio Television Hong Kong.
- Sound systems in city halls, computer controlled score boards and the Space Museum's Planetarium.

This functional area also covers the increasing new business with China. In perhaps over-simplified terms, CWHK views telecommunications development with China as its largest potential growth area. (See Figure 1 for telephone traffic volumes between Hong Kong and China.) Current statistics show that China is the fifth largest market for international telephone calls out of Hong Kong (Figure 2). That situation will soon change if predictions from CWHK engineers are fulfilled. On March 17, 1981, an agreement was signed in Guangzhou in China, between the Guangdong Posts and Telecommunications Bureau (GPTB) and CWHK for an HK$32 million (approximately $4.3 million U.S.) microwave link to expand the route from South China to Hong Kong. This new 2700 channel system will link Hong Kong to Shenzhen and Guangzhou, and is supplementary to an existing land coaxial cable system that was installed in 1974 carrying 300 channels. Saturation of the cable route is due to be reached next year and the new microwave system's capacity is planned for a 10-year life.



*CWHK's second automatic telex exchange was installed at Hermes House in Kowloon in 1981.*

Heading the CWHK China project team for the microwave link is Fung Hak Ming, general manager of Local Engineering. The system will have a main link, tail links, repeater stations and a land coaxial element. Link tests are scheduled to be performed in early August. The system is expected to be ready for service by the end of August.

The Hong Kong-Guangzhou link will feed telecommunications traffic into a planned microwave system that will eventually stretch 975 kilometers and span the entire province of Guangdong. This 25-hop system, designed to handle up to 2700 channels, will link Hong Kong, Shenzhen, Zhuhai, Dongguan and Guangzhou. The first phase of this microwave system, which is due to be completed in 1984, will connect Haikou on Hainan Island with Guangzhou. The link to Shantou, which will complete the system, is planned to be ready for service the following year. The system will be capable of carrying 960 telephone conversations simultaneously, as well as full-color television program signals. There will be automatic protection against failure; reliability will be further improved by the use of energy-saving solar power generators at repeater stations.

*The message switching in New Mercury House handles more than 5 million messages per month.*

Another area of interest with China is the oil exploration business in which Cable and Wireless plc is providing the telecomunications links with China's offshore oil rigs.

The International Enginering group is responsible for international outlets, back-hauls and interstation links. It plans, installs and maintains the satellite earth station, submarine telephone cable station, microwave, tropospheric scatter, VHF/UHF (very high frequency/ultra-high frequency), HF (high frequency band) radio, ship-shore station, IMCs (international maintenance centers), ISTCs (integrated switching and testing centers) and international telephone switching centers.

When the first antenna at the satellite earth station was brought into service in 1969, it had only 22 channels. This year there are four 30-meter

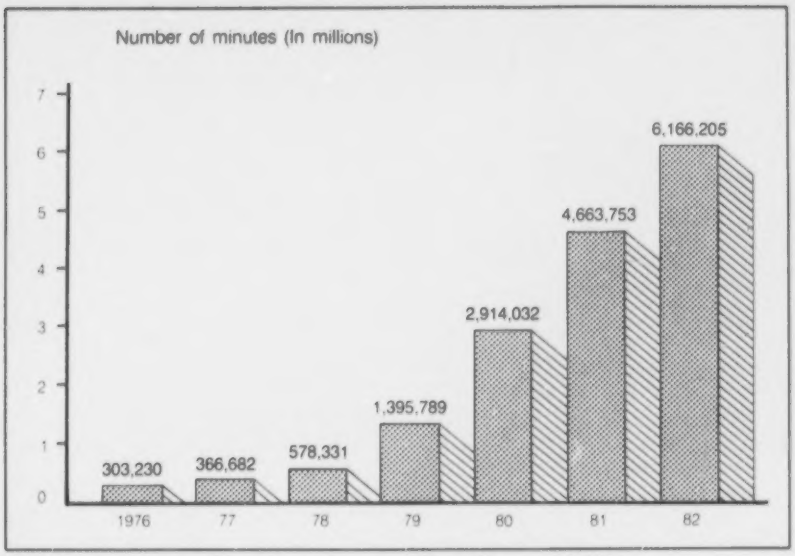



**FIG. 1** *Telephone traffic volume between Hong Kong and China.*

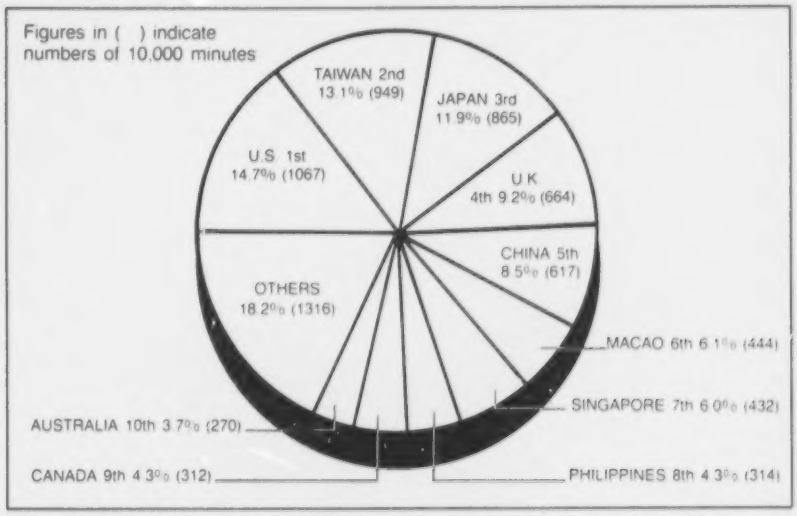

Figures in ( ) indicate numbers of 10,000 minutes
TAIWAN 2nd 13.1% (949)
JAPAN 3rd 11.9% (865)
U.S. 1st 14.7% (1067)
U.K 4th 9.2% (664)
CHINA 5th 8.5% (617)
OTHERS 18.2% (1316)
MACAO 6th 6.1% (444)
SINGAPORE 7th 6.0% (432)
AUSTRALIA 10th 3.7% (270)
CANADA 9th 4.3% (312)
PHILIPPINES 8th 4.3% (314)

**FIG. 2** *Top 10 destinations for international telephone calls during 1982.*

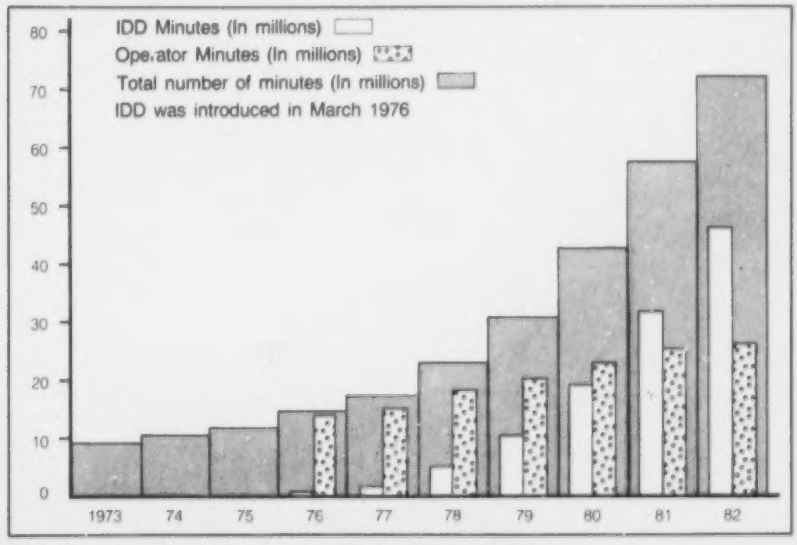



**FIG. 3** *International telephone calls from Hong Kong.*

antennas at the earth station using over 1000 satellite channels. One of these will replace the 1969 antenna. There are 28 countries connected with Hong Kong via the Indian Ocean satellite and 19 connected via the Pacific Ocean satellite. To take advantage of the INTELSAT V (International Telecommunications Satellite consortium) digital system, the earth station is being supplied with time division multiple access/digital speech interpolation (TDMA/DSI) equipment, to cope with further expansion through the Indian Ocean satellite. Since reliability is important, the new earth stations are designed to withstand severe weather conditions, such as the typhoon conditions which are common in the area. The two new 30-meter diameter dish-shaped aerials are designed to remain operational in wind speeds up to 118 mph (miles per hour) and survive wind speeds up to 210 mph.

There are three submarine coaxial telephone cables radiating from the deep water bay coaxial cable terminal: SEACOM B (Southeast Asia Commonwealth Submarine Cable System) to Singapore via Kota Kinabulu, SEACOM F to Australia via Guam and OLUHO (Hong Kong-Okinawa-Philippines cable system) to Japan via Currimao in the Philippines. It has been proposed to increase the capacity of SEACOM using circuit multiplying equipment (CME) similar to time assignment speech interpolation (TASI).

In December 1982, an agreement was signed in Taipei between the Telecommunications Authority of Singapore, CWHK and the International Telecommunications Development Corp. of Taiwan to construct a submarine cable system linking Singapore, Hong Kong and Taiwan (SINHON-TAI). The section of the submarine cable between Hong Kong and Taiwan is designed to replace the existing Hong Kong-Taiwan tropospheric-scatter system which, after 15 years of service, will be discarded. The new cable system will further diversify connections to overseas countries and interconnect with submarine cable systems in the Pacific region.

It also will have access to the Assn. of Southeast Asian Nations (ASEAN) submarine cable network through Singapore, interconnect with the proposed cable system across the Indian Ocean to Europe, and link up with the planned cable route to Indonesia and Australia. The SIN-HON-TAI cable sys-

*Continued on page 40*

tem is expected to be ready for service toward the end of 1985.

The first working optical fiber cable system in Hong Kong was installed by CWHK between Hermes House and New Mercury House in 1981. It was used to connect 8000 telex subscribers from Kowloon to the automatic telex exchange (ATX) in New Mercury House before the Hermes House ATX was put into service in May 1982. It is used now to provide inter-ATX junctions and inter-ITSC (International Telephone Switching Center) circuits between the two buildings.

Two optical fiber cables are used, one through the cross harbor road tunnel and the other through the cross harbor underground railway tunnel. There also is a comprehensive coaxial cable and microwave system to link Hermes House into the back-haul hypergroup network from the earth station and submarine cable terminal. New Mercury House also forms a node in the back-haul network; it is possible to reroute traffic around the system if any section of the network is affected by typhoon damage or interference.

The international telephone service is jointly provided by CWHK, which has responsibility for international switching and overseas connections, and Hong Kong Telephone Co., which provides the local telephone network and operator assistance. International phone calls provide one measure of the traffic increase. International telephone calls from the territory represented 5.3 million minutes in 1971, rising to 14.5 million minutes in 1976 and 57.8 million minutes in 1981. Figures for 1982 show a 20% increase over 1981 (Figure 3). At the present time, all the international telephone calls are switched by a stored program control (SPC) exchange manufactured by Ericsson, in the International Telephone Switching Center, in New Mercury House. This exchange was installed in 1972 and has been expanded to be equipped for 1360 C5 signaling and 900 C6 signaling international circuits. It is capable of handling 31,600 calls per hour. The new ITSC being installed in Hermes House this year is also an SPC exchange. It is an Ericsson digital switching system with ultimate capacity for 60,000 channels. Initially, it will be equipped for a total of 2920 international circuits and will be capable of handling 39,000 call attempts per hour.

The company's Telecommunications Services and Marketing group covers customer services and marketing. Its telex subgroup includes the provision of the two SPC automatic telex exchanges in Hong Kong. The exchanges are computer controlled and manufactured by Hasler of Switzerland. Each has an initial capacity of 15,000 lines, with the New Mercury House switch now providing 9900 telex subscribers and the Hermes House providing 9200 telex subscribers. The ultimate capacity of each exchange is 32,000 telex subscribers. A standard feature of the Hong Kong telex service is the capacity to store and forward outgoing telex messages if telecomunication lines are busy. The subscriber is subsequently notified by telex when the message is finally forwarded.

The message switching subgroup also is expanding its operations. A large computer message switch for the use of private customer networks has just been commissioned. This is the Vanguard system, designed and installed by Cable and Wireless. The message switching center (MSC) has expanded rapidly since starting up in 1969. It is now the largest real time switching center in Asia and the Far East, handling over 5 million messages per month at a peak output rate of 38,000 messages per hour. The new Univac 1100/62 system for Vanguard is planned to replace all the current Univac 418/11 and 418/111 systems that cater for 150 subscribers and almost 2000 leased circuits and, at the same time, to provide for expansion to meet increased demand with enhanced facilities.

Many private customer data networks are hubbed from equipment in New Mercury House and an international public packet switched data network which is available through IDAS (International Database Access Service). Hong Kong IDAS subscribers can connect with data subscribers of Tymnet and Telenet networks in the U.S., Datapac in Canada, International Packet Switched Service (IPSS) in the U.K. and Radio Suisse network in Switzerland.

A high-speed facsimile (FAX) service is available to 25 countries through the Bureaufax system. FAX services, as measured by usage, have grown increasingly popular.

Future developments include an electronic mail facility and teletex. Teletex is designed to provide international high-speed data transfer between teleprinter terminals that can communicate automatically, computer to computer, using the internationally accepted CCITT (International Telegraph & Telephone Consultative Committee) teletex standard. Unlike telex, it will not be limited to one network but will be able to use the packet switched network, the public telephone network and the current worldwide telex network. Electronic mail is expected to be launched as a CWHK service in Hong Kong this year, as part of general office automation. □

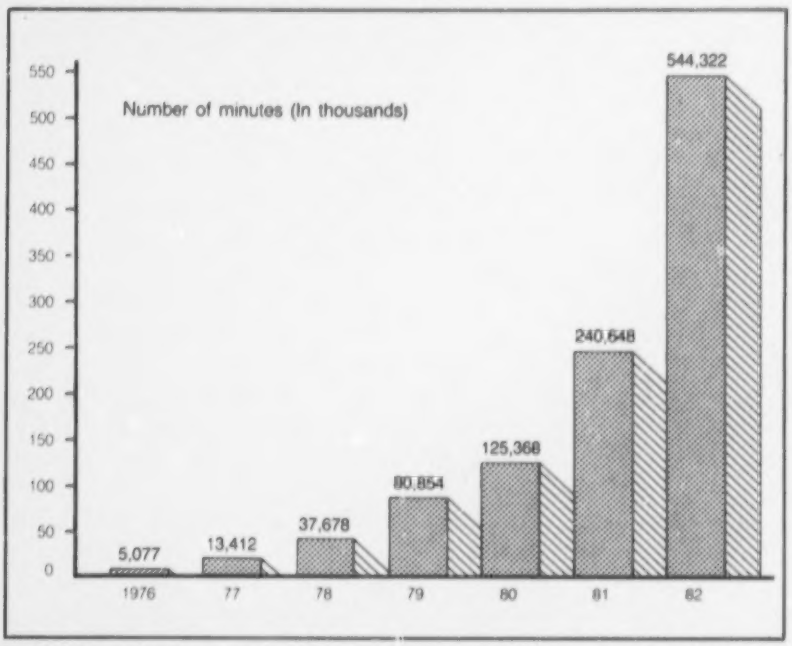



**FIG. 4** *Growth of international facsimile service and international packet switched data (IPSD).*

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**Published by TELEPHONY PUBLISHING CORP., 55 E. Jackson, Chicago, IL 60604**
**Telephone 312/922-2435; TWX 910 221 1058**

**European Bureau, 136 Broomfield Rd., Chelmsford, Essex CM1 1RN, England;**
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TELEPHONY (ISSN 0040-2656/83-0+$1.50) is published weekly (except twice weekly during the second week of August and three times during the month of December) by Telephony Publishing Corp. Officers of Telephony Publishing Corp. are Dan S. Fargo, President; Leo Anderson, Executive Vice President; Del Myers, Ed Robinson and Robert Wehofer, Vice Presidents. Postmaster: Please send form 3579 to Subscription Dept., TELEPHONY, 55 E. Jackson Blvd., Chicago, IL 60604. Second class postage paid at Chicago, Ill., and at additional mailing offices. Single copies (payable in advance) U.S. $3.00 ea., issues over 2 years old $3.50 ea. Outside U.S. add $1.00 ea. Subscriptions: $29 one year. Outside U.S. add $20 per year. Subscription rates apply to employes of operating telephone companies; telephone consultants; contractors; interconnect companies; specialized common carriers; military government associations; private communications users; schools; libraries. All others $35 one year. Outside U.S. add $20 per year. Change of address: include old address as well as new address. Attach issue label if possible. Allow 4 weeks for change to become effective. Copyright 1983 by Telephony Publishing Corp. Permission to photocopy for internal or personal use or the internal or personal use of specific clients is granted by Telephony Publishing Corp. for libraries and other users registered with the Copyright Clearance Center (CCC) provided that the fee of $1.50 per page is paid directly to CCC, 21 Congress St., Salem, MA 01970. Special requests should be addressed to Telephony Publishing Corp.

# North American installations of time division digital switches

AMOS E. JOEL JR.

When Amos Joel Jr. retired from a switching career that spanned more than 42 years at Bell Telephone Laboratories, inaction did not set in. He currently is serving AT&T International as an executive consultant, planning a special issue of the IEEE (Institution of Electrical and Electronic Engineers) Transactions on "Telecommunications Switching Technology to Serve Business" (see page 31) and planning to journey to Geneva, Switzerland, in October to receive the International Telecommunication Union's 2nd Centenary Prize during Telecom 83 (TELEPHONY, July 25, p. 88). Meanwhile, he has updated his periodic survey of North American time division switching installations (TELEPHONY, June 21, 1982, p. 32). The results, through December 1982, are presented here.—*Editor*

## North American time division digital switching (1982)

| System(s) | ITT/North 1210 | No. 3 EAX | No. 5 EAX | NEAX 61 | DCO | DMS 10 | DMS 100/200/300 | ITS 4/5 | No. 4 ESS | No. 5 ESS | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Base units in service YE 82 | | | | | | | | | | | |
| a) Total | 163 | 36 | 10 | 78 | 292 | 612 | 263 | 183 | 90 | 2 | 1729 |
| b) Class 5 | 111 | | 10 | 63 | 286 | 597 | 148 | 125 | | 2 | 1342 |
| c) Class 4/5 | 42 | | | 13 | 5 | 14 | 67 | 41 | | | 182 |
| d) Class 4 | 10 | 36 | | 2 | 1 | 1 | 27 | 17 | 90 | | 184 |
| e) Other | | | | | | | 21 | | | | 21 |
| 2. Number of remote switching units in service YE 82 | | | | | | | | | | | |
| On base units | 75 | | | 49 | 141 | 145 | 248 | 319 | | | 977 |
| 3. Number of total lines in service YE 82 | 573K | | 25K | 323K | 509K | 896K | 1857K | 308K | | 3K | 4494K |
| 4. Number of trunks in service YE 82 (Class 4 or 4/5) | 57K | 204K | | 16K | 53K | 3K | 297K | 19K | 2713 | | 3362K |
| 5. Total systems and lines on order or expected YE 83 | | | | | | | | | | | |
| Systems | N/A | 39 | 650 | 145 | | 1175 | 550* | N/A | 98 | N/A | |
| Lines | N/A | N/A | 3M | 320K | | 1.5M | 5M | | NA | N/A | |
| Trunks | N/A | 250K | NA | 139K | | NA | 700K | | N/A | N/A | |

*+525 remotes
N/A - Not Available
NA - Not Applicable

## North American time division digital switching (largest offices)

| | Local | | Toll | | Local/Toll | | |
|---|---|---|---|---|---|---|---|
| System | Location | Line | Location | Trunks | Location | Terminations |
| ITT/North 1210 | Jeff. City, Mo. | 20K | Jeff. City, Mo. | 2.3K | Roseville, Calif. | 4K |
| No. 3 EAX | NA | NA | Calgary, Alberta | 5.8K | NA | NA |
| No. 5 EAX | First Colony, Texas | 6K | | | | |
| NEAX 61 | Victorville, Calif. | 13.7K | Winter Park, Fla. | 5.8K | Thomaston, Ga. | 10.4K |
| DCO | Ville Platte, La. | 7.5K | Boscobel, Wis. | 1K | Middleton, Wis. | 10.8K |
| DMS 10 | Harrison, Ark. | 6K | Pearce, Ariz. | 250 | Pinetop, Ore. | 2.1K |
| DMS 100/200/300 | Toronto | 43.5K | Toronto | 23K | Kitchner, Ontario | 40K |
| ITS 4/5* | St. Mary's, Ga. | 7K | Gander, Newfoundland | 1.2K | Mauston, Wis. | 6.5K |
| No. 4 ESS | NA | NA | Los Angeles, Calif. | 70.4K | NA | NA |
| No. 5 ESS | Cedarville, Ohio | 2K | | | | |

NA—Not Applicable
*—1981 data

# The future of mobile communications and the ISDN

JAN E. ENGEBRETSON and JAN AUDESTAD

THE INTEGRATION of data and telecommunication technologies leads to rapid growth in the possibilities of handling all kinds of information. Land-based wired networks are being enhanced and developed for this purpose.

Mobile communication systems represent an important addition to these networks. Mobile communication devices carried by the individual can be used both at work and at leisure.

During the '80s, several land mobile networks will be put into operation in Europe. Some of them are based on the Nordic Mobile Telephone (NMT) system. Others are based on the NET-C system developed in the Federal Republic of Germany and one is based on the Advanced Mobile Phone Service of American Telephone & Telegraph Co. These networks incorporate such functions as:

- **Location registration.** The network automatically keeps track of where the mobile stations are located. Based on this information, it routes the calls to the proper location of the mobile station.
- **Call transfers.** When a mobile station moves from the area of one base station into the area of another during a conversation, the call is automatically transferred to the new base station without interrupting the call.
- **Call diversion.** The mobile subscriber may indicate that he wants all calls diverted to a given number in the fixed telephone network or to a specific recorded announcement.

The introduction of such facilities is a major step toward the modernization of land mobile communications. However, the networks that will be put into operation during the next 5 or 6 years are optimized for telephony. They are not appropriately designed for carrying such new services as teletex, digital facsimile or other digital services transported in the wired public networks.

Land mobile networks which are put into operation during the '80s will have a life span of at least 15 years. They will still be in operation toward the year 2000, long after the integrated services digital network (ISDN) has been introduced. It is important that the land mobile networks match the wired networks so the whole spectrum of new services can be offered through them. This implies that planning of the land mobile ISDN has to start now in order for it to be put into operation during the '90s. Before discussing the land mobile ISDN, an examination of the present situation is in order.

The importance of land mobile communications for modern society is well illustrated by the situation in Norway.

The first land mobile system in Norway, which offered nationwide manual service, was put into operation in 1967. In November 1981, the automatic NMT system was introduced in the eastern part of Norway. By 1985, the system will cover the entire country.

The NMT system is also used in Denmark, Finland and Sweden. The NMT networks of the four Nordic countries are interconnected by location registers. Subscribers in one

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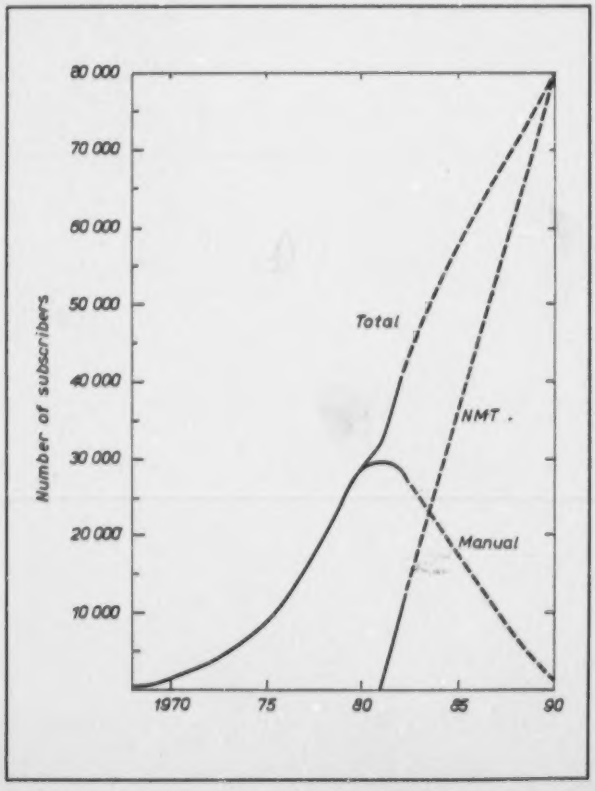


**FIG. 1** *Number of land mobile subscribers in Norway.*

*Jan E. Engebretson* and *Jan Audestad* are both Engineers with the Norwegian Telecommunications Research Establishment in Oslo. This article was adapted from a paper presented at NORCOM '83, held May 3-7 in Oslo.

country may use their equipment in the other countries.

Since 1967, the number of land mobile subscribers in Norway has increased steadily (Figure 1). By the end of February 1981, Norway had about 30,000 subscribers of the manual service and about 13,000 subscribers of the automatic service. During the '70s, the manual service showed an annual growth of 300 to 400 subscribers. In contrast, the NMT system had 10,000 subscribers during the first year of operation. Figure 1 also shows the projected number of subscribers in 1990 when there will be approximately 80,000 land mobile subscribers. Around 1987, the NMT system in the 460 MHz (megahertz) band will become too congested. Therefore, planning has started on a supplementary system in the 900 MHz band based on NMT specifications.

Table 1 shows the current and expected number of cars equipped with mobile telephones: 3% of all cars are so equipped today; by the year 2000 this number will increase to 10%. By then 5% of all telephones in Norway would be mobile telephones.

The traffic in terms of the number of successful calls per year made by land mobile subscribers is shown in Figure 2. In 1982 the subscribers of the automatic service made 4 million calls, which is about the same number of calls made by the much larger number of manual subscribers. One reason for this is that the first users of the NMT system were people who needed a fast, reliable land mobile service. This assumption also is confirmed by Table 2, which compares average and busy hour traffic per subscriber for manual and automatic service. In the automatic service, the busy hour traffic per subscriber is four times the level of the manual service.

A recent market survery made among NMT subscribers shows a number of interesting points. The main users of the service work in five fields: sales (24%), construction (21%), transportation (18%), industry (14%) and services (13%). On average, each company had three NMT mobile stations. Most of them claimed that the main reason for using NMT equipment was to improve their efficiency; in other words, to avoid unnecessary driving and to increase their mobility.

## Regional characteristics

The NMT system incorporates the location registration facility with the location registers of the four Nordic countries interconnected. The importance of this facility is illustrated by the fact that 13% of Norwegian subscribers have a requirement for also using their stations in other Nordic countries.

The NMT system also offers other benefits. The most important of these, as far as usage is concerned, is the diversion of calls to a number in the telephone network selected by the mobile subscriber. More than 50% of the subscribers have used this facility and 10% use it daily. Diversion of calls to a standard announcement and the prohibition of outgoing calls are capabilities which are used less frequently.

There is also increasing interest in non-voice services. Right now, telex represents 6% of usage; data transmission, 6%; facsimile, 5%; and video, 1%.

Except for telex, these services are now offered by using the same interfaces used for telephone circuits. However, the interest in these services seems to be large enough to justify direct interconnection with public data networks or the ISDN in the future.

The price of mobile stations and of charges per minute are shown in Figure 3. The real value price of manual stations has decreased to about 50% of the 1967 price. Even at the outset the real value price of NMT stations was less than the real value price of manual stations in 1967. During the last year, the price of NMT stations

*Continued on page 110*

**Table 1**

| Year | Number of cars in millions | Number of mobile telephones | Relative number of cars equipped |
|---|---|---|---|
| 1982 | 1.3 | 40,000 * | 3% |
| 1990 | 1.5 | 80,000 † | 6% |
| 2000 | 1.6 | 160,000 † | 10% |

*Manual and automatic system
† NMT forecast

**Table 2**

| | Manual service | Automatic service |
|---|---|---|
| Average | 0.0015 | 0.003 |
| Busy hour | 0.0033 | 0.013 |

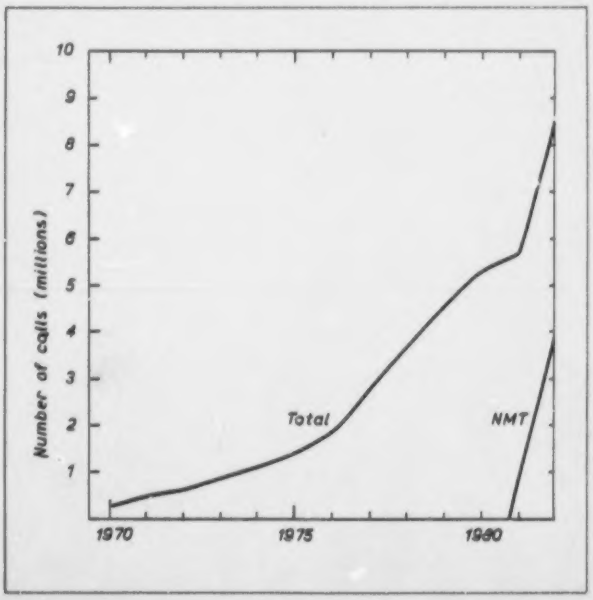


**FIG. 2** *Number of successful calls per year.*

**FIG. 3** *Development of cost of mobile telephone equipment and charges relative to the consumer price index since 1967.*

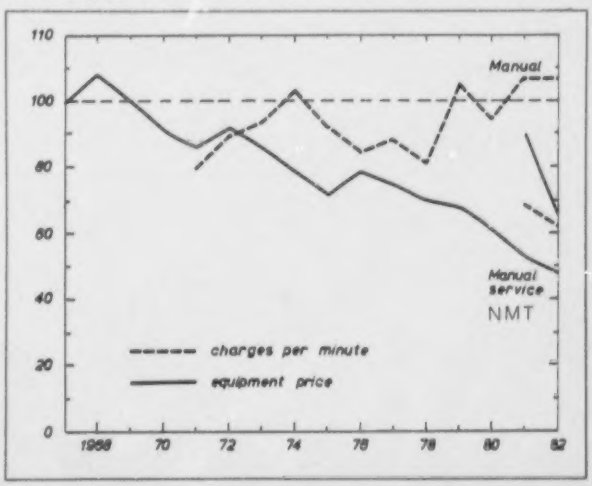

**FIG. 4** *Plans for and status of land mobile systems in Europe.*

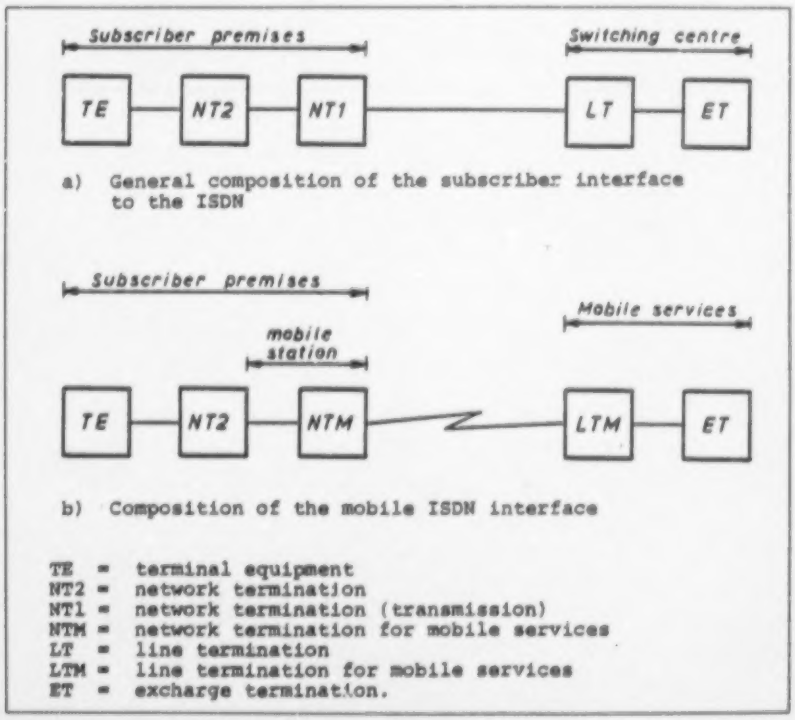


**FIG. 5** *The ISDN concept applied to mobile systems.*

has dropped considerably. It is now comparable to the price of manual stations.

Charges for the manual service have more or less followed the general price development. For the NMT system the charges per minute are only 50% compared to the manual service. The charges are in fact even more favorable for the NMT system. Charges are based on 20 second intervals while the manual service is based on 1 minute intervals.

Internationally, Study Group II of the International Telegraph and Telephone Consultative Committee (CCITT) recently made a survey among member administrations on land mobile networks. Altogether 53 national telecom administrations (PTTs) or private operating agencies answered the questionnaire. Of the organizations which answered, 25 were already operating an automatic network and 11 more were planning to have one before 1990.

Most existing automatic networks were small. Only six automatic networks had more than 5000 subscribers, and only two had more than 15,000. By 1990 the number of subscribers was expected to increase on average by a factor of five, which indicates a rapid growth in land mobile communications.

A majority of the 25 administrations which already had an automatic network indicated that they would need a new network before 1990. Several reasons were given:

- The existing network did not offer nationwide coverage.
- New functions, such as location registration and diversion of calls, were required.
- The existing network was congested and did not have enough frequencies to meet the increase in traffic.

None of the administrations, except for the Nordic administrations, had plans for harmonizing their networks with networks in adjacent countries. This illustrates one of the main problems in land mobile communications: incompatibility between networks. The situation is demonstrated in Figure 4, where the various systems to be put into operation in Europe during the '80s are indicated. Great efforts have been made to standardize subscriber interfaces and end-to-end protocols for other telecommunications services, for example in public data networks and the ISDN. This not only ensures proper interworking among sub-

*Continued on page 114*

scriber terminals located in different countries or in different networks, but also results in cheaper equipment for a vast international market.

**Bad situation**

The current situation in the land mobile field is exactly the opposite. Important standardization work now is going on in the CCITT, but most European countries have shown little interest in this work. The CEPT (European conference of postal and telecommunications administrations) has also started working on a future land mobile system for Europe. But in this project, a lack of enthusiasm from many countries also is apparent. What is now required is a firm policy statement from national telecommunications authorities that such a system has to be introduced within a given time.

The market potential for land mobile equipment in Europe was assessed in a study made for the Eurodata Foundation in 1981. The study showed a need for between 5 million and 20 million land mobile stations, depending on price and, in particular, on their competitiveness against paging equipment. This clearly indicates that the market is big enough to encourage the development of a common European system which would provide services to all land mobile subscribers independent of their home country. If such a system is introduced in the early 1990s, it will supplement existing networks and replace them as these networks become obsolete.

Future land mobile networks may be divided into three groups:

- public land mobile networks;
- closed user group networks; and
- mobile local area networks (mobile LANs).

Each type of network would be required in order to meet specific customer needs.

The future public land mobile networks should be designed in accordance with the principles laid down for the ISDN. This implies that mobile stations should be capable of interfacing ISDN-compatible terminal equipment.

The principle is illustrated in Figure 5 where the standard ISDN interface is shown with the equivalent mobile interface.

The ISDN interface consists of the following elements on the subscriber side:

- the terminal equipment (TE), which corresponds to the actual subscriber terminal (in other words, the telephone hand-set); and
- the network terminations, NT 1 and NT 2, where NT 2 incorporates the necessary function for operating a multiterminal interface and NT 1 is the termination of the physical line.

On the exchange side two elements are required:

- the line termination, LT, which is complementary to NT 1; and
- the exchange termination, ET.

As shown in Figure 5, the land mobile system should be designed so that only the functions NT 1 and LT are different from those of the general ISDN interface. When this condition is satisfied, any type of terminal equipment used in fixed locations also may be connected to a mobile station.

The standardization of NT 1 and LT functions for land mobile applications would require considerable work in order to incorporate all procedures which are unique for mobile networks, such as location register updating and call transfer procedures. Due regard should be paid to the open system interconnection (OSI) architectural model being specified by the CCITT and the ISO (International Standards Organization).

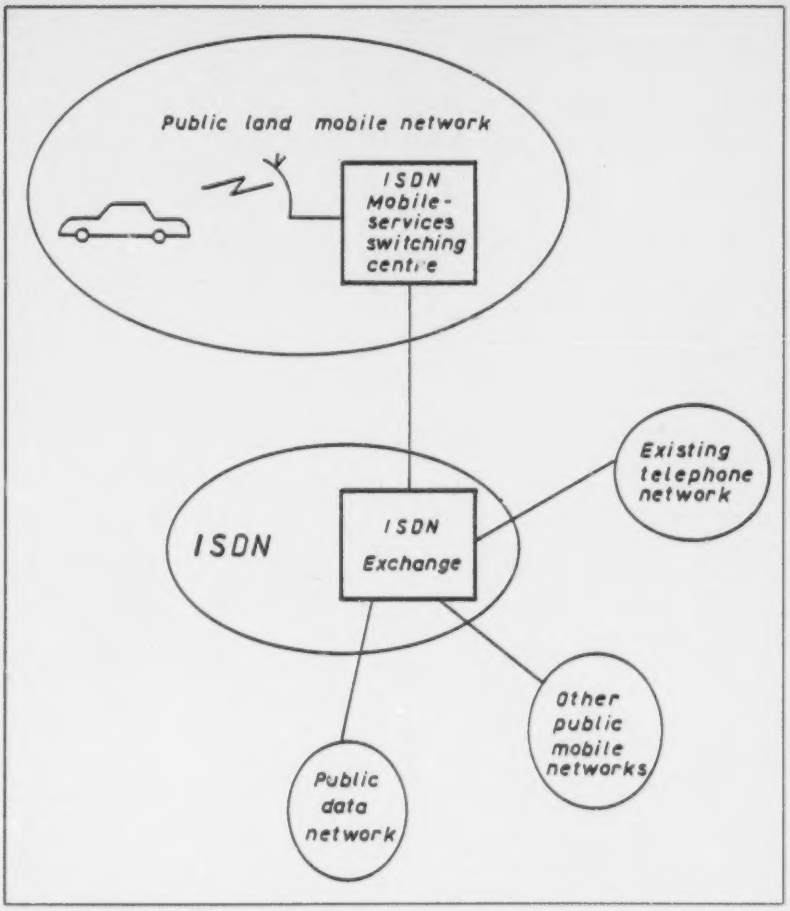


**FIG. 6** *Interconnection of a public land mobile network to other network.*

Mobile services switching centers (MSCs) should also be designed in accordance with ISDN specifications. The MSC should interface the fixed network through an ISDN exchange. Since interworking must exist between the ISDN and other public networks, these functions will not be required at the MSC, thus simplifying the equipment. The overall configuration is shown in Figure 6.

Study Group XI (signaling and switching) of the CCITT recently decided to specify a mobile user part (MUP) of signaling system No. 7. The purpose of the MUP is to accommodate the variety of procedures which are required between public land mobile networks when subscribers are permitted to roam among them. Such procedures would include updating location register information, exchanging other information related to a given mobile station (activation or cancellation of supplementary services) and transfering charging information. Thus, MUP

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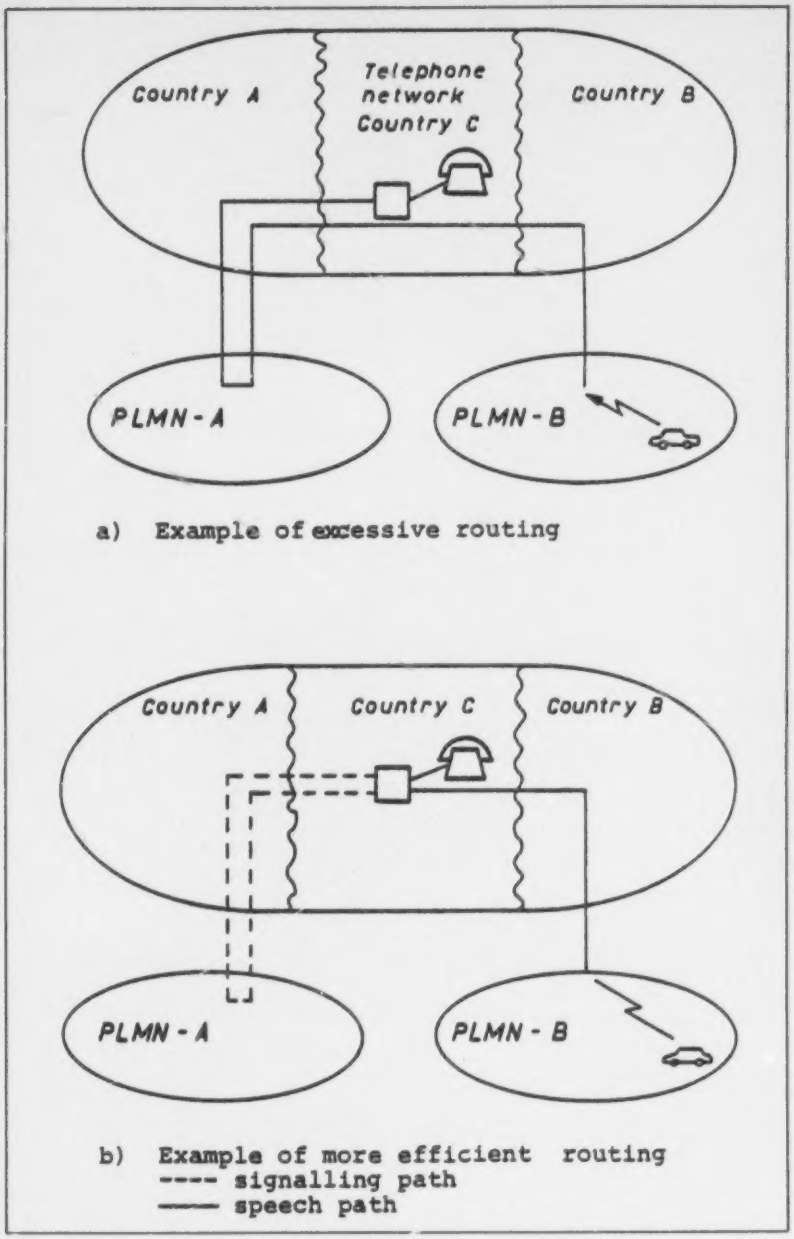


would represent a standard method of interworking among different land mobile networks, where the required information is passed via the signaling network of signaling system No. 7. Therefore, a separate signaling network among land mobile networks would not be required.

A major problem with mobile subscribers is that, if special precautions are not taken, the route from a calling subscriber of the fixed network to the mobile subscriber may become very long. This is illustrated in Figure 7a. In the example, a subscriber of country *C* is calling a mobile station registered in country *A* which has traveled to country *B*. With the existing telephone network, the speech path has to be routed to mobile network *A* first, be switched there and then be routed all the way back again to mobile network *B*.

However, Study Group XI is now considering possible extensions of the telephone user part (TUP) of signaling system No. 7 so that the loop through mobile network *A* on the speech path can be avoided. This can be done as shown in Figure 7b where the telephone network (or the ISDN) of country *C* has the capability of interrogating the location register of mobile network *A*. Based on routing information provided by mobile network *A*, the exchange of country *C* making the interrogation may route the call directly to mobile network *B*. In this case, only a signaling link has to be established between country *C* and mobile network *A*.

The same method would also be used if the called mobile subscriber has requested the activation of the

*Continued on page 120*

**FIG. 7** *Routing of calls to a roaming land mobile subscriber.*

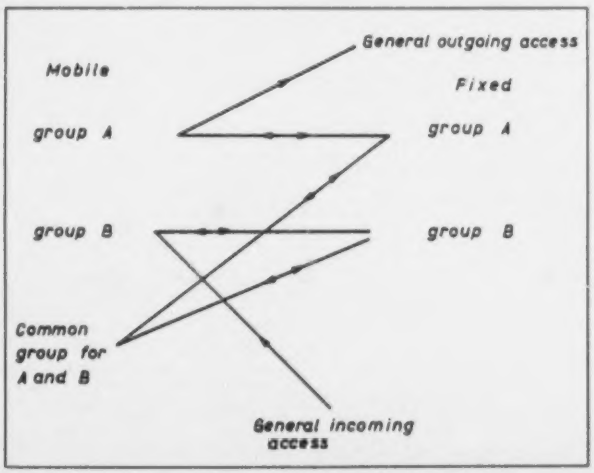


**FIG. 8** *Example of two groups of users forming the following closed user groups: Group A has outgoing access from the mobile stations; Group B has incoming access to the mobile stations; there is also a common group for Group A and Group B which is closed from all access outside the group.*

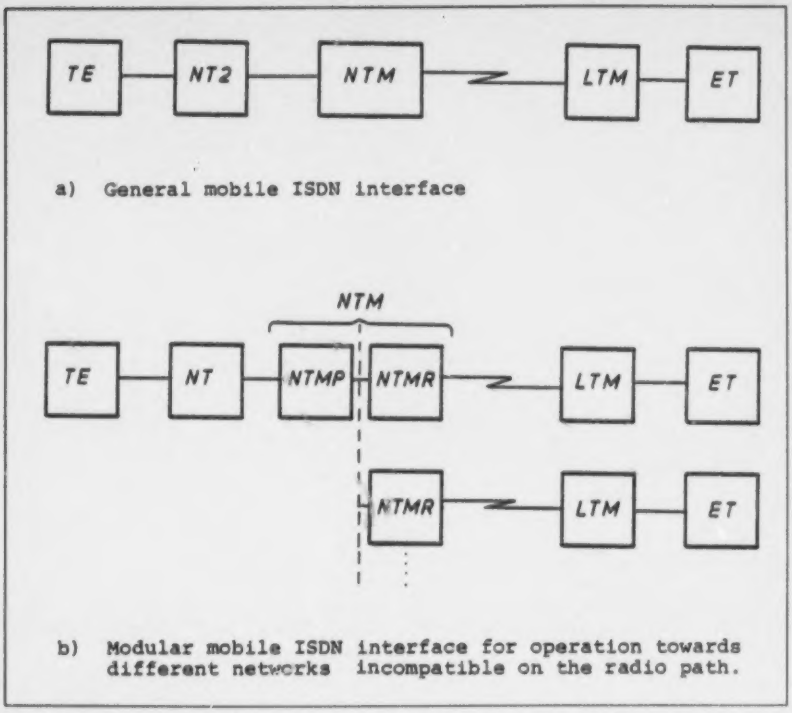


**FIG. 9** *Modular network termination for interconnecting mobile stations to a variety of mobile networks.*

call diversion procedure.

Therefore, the studies now being undertaken by Study Group XI on land mobile systems are very important for the future development of compatible interconnected land mobile networks.

The field of applications of land mobile communications is expected to expand in the future. A growing demand for non-voice services has already been detected in Norway. Mobile stations are not only used in cars but also on commercial ships, on pleasure boats, in trains and at fixed locations where connection to the telephone network otherwise would be too expensive. In order to meet specific communications requirements for supply ships in the North Sea, the heaviest traffic areas now are covered with NMT antennas directed toward the sea. Applied in a similar way, a future common European land mobile system would meet the communications requirements of the commercial fleet operating along the coast of Europe. This recently has become important because an international short range maritime system will not be developed until a common international frequency band exists for such a service.

## More, more

There is also a growing demand for hand portable stations, mobile payphones and even mobile PABXs (private automatic branch exchanges). The latter would solve some of the communications problems at construction sites.

The concept of closed user groups was introduced for public data networks. The closer user group facility permits users to operate their own closed network within a public network; in other words, they neither are accessible by subscribers not belonging to the group nor can they access subscribers outside the group. In many cases, this is a severe restriction. Therefore, it is also possible to form groups with incoming or outgoing access. The former permits subscribers not belonging to the group to access subscribers within the group. The latter permits the opposite.

Within a public land mobile network, the closed user group facility should be made available in order to attract some subscribers who would otherwise prefer to have their own closed radio network. However, the implementation of closed user groups in land mobile networks may have implications for fixed networks. Land mobile subscribers normally would want to form closed user groups with fixed subscribers. Therefore, this facility should be incorporated in the ISDN and the control of closed user groups should be specified for signaling system No. 7.

Another way of implementing closed user groups is for the national telecom administration to establish a specific network for this purpose. The various groups would thus be using a common radio frequency spectrum. This would result in better frequency utilization and a cheaper network for each user group compared to the case when each group was operating a separate radio network.

Furthermore, users with a common interest (for instance, police and ambulance services) may decide to

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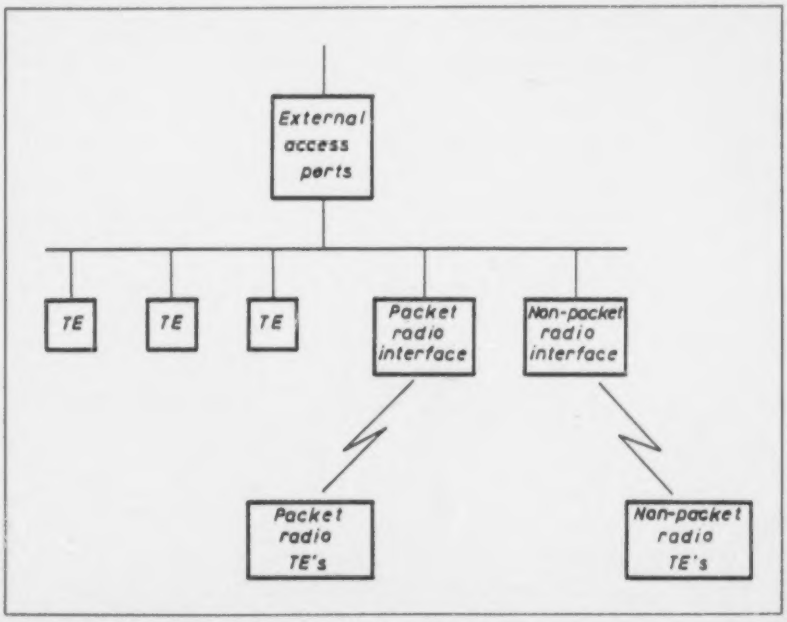


**FIG. 10** *Local area network with radio interfaces.*

form a common group.

A user group may be either national or local. An example of some of the combinations that may exist for two groups is shown in Figure 8. Groups may have different closure conditions depending on the service; for instance, a group may be open for telephony but closed for data transmission.

Closed user group networks thus may become a competitive alternative to private networks. To make it even more competitive, mobile subscriber interfaces and protocols used on the radio path should be designed in accordance with those of the public land mobile network.

By subdividing the NMT function into a procedure part, NTMP, and a radio part, NTMR, as shown in Figure 9, the basic NTMP function may be used on a variety of networks operating in different frequency bands and with different modulation techniques on the radio path. Such a development should be taken into account when designing both public land mobile networks and closed user group networks.

During the last few years, great efforts have been made to improve local area communications. Possible solutions include sophisticated digital PABXs and high speed transmission systems, such as Ethernet.

In order to provide for the mobility of persons within the premises, PABXs incorporate functions like call diversion, hunting and automatic recall. Local radio paging has also been used to contact mobile users. All of these facilities have disadvantages. They are not always what the user wants.

User requirements can often be better met by mobile LANs. Mobile LANs would have to provide full duplex telephone service in some cases and full duplex data transmission service in other cases.

These diverse user requirements may be met with an LAN configuration as shown in Figure 10.

In the future, the LAN may consist of a variety of fixed interfaces and a number of different radio interfaces. For example:

- a packet radio interface for high speed data interconnections; and
- a non-packet interface for telephone and various forms for data transmission.

For telephony, the mobile equipment should be hand or pocket portable and about the same size as radio paging receivers. It should be possible both to receive and originate calls from mobile equipment.

With regard to communication protocols, mobile equipment should be fully compatible with fixed installations. This requirement is necessary to avoid expensive additional interfaces in PABXs or at other access points to which the equipment is interconnected.

The radio cells associated with mobile LANs should be small in order to facilitate efficient re-use of frequencies. The cell radius should be of the order of 100 meters or less.

**'It is important that land mobile networks match the wired networks so the whole spectrum of new services can be offered through them. This implies that planning of the land mobile ISDN has to start now. . .'**

The concept of mobile LANs may be extended to incorporate a more general public micro-cell telephone service for the home and the cordless telephone. A public micro-cell may be used for covering an airport, a shopping area or a public park. It may be possible to access these networks by a cordless telephone or a portable phone used in an LAN. However, there are a number of technical and operational problems that must be resolved before a general mico-cell system can be realized.

These problems include:

- numbering and identification plans;
- charging; and
- location registration and location register updating.

If a common solution can be found for the cordless telephone, mobile telephones used in LANs and the public micro-cell systems, there will be an enormous market for such equipment, according to the study done for the Eurodata Foundation in 1981. If an inexpensive terminal which cost about $100 were designed, the European market alone is capable of consuming 165 million terminals.

In the past there has been virtually no cooperation among countries regarding land mobile networks. The Nordic countries are the exception. There a common effort has resulted in a technically advanced mobile system. Internationally, standardization of land mobile services is under the province of Study Group VIII of the CCIR (International Radio Consultative Committee). Despite several years of effort in this field, little has been accomplished. The first real initiative came from the CCITT, where the need for international standardization of services is better appreciated. However, standardization of mobile services includes aspects which are unknown in other fields, such as:

- allocation of a common frequency band with sufficient capacity to accommodate the required number of subscribers;
- agreement between countries on the use of land mobile equipment in countries other than the user's home country; and
- harmonized procedures for type approval.

For a common public land mobile system for Europe, the first point is resolved by using the land mobile band in the 900 MHz range. However, this band may not have sufficient capacity for the future. With regard to the other networks, the frequency situation is by no means clear.

The second point is far more complicated since it involves political factors beyond the scope of telecommunications authorities.

International harmonization of type approval procedures has been unsuccessful. Since this is within the responsibility of the national telecommunications administrations, it is likely that a solution will be found only after the decision for introducing the service has been made.

In spite of all the difficulties which must be resolved, truly individual communication will develop out of it. Transceivers will be considered simple extensions of paging devices, like the portable entertainment radio receivers commonly used today. Together with mobile cellular systems, these devices will represent exciting new possibilities for individual two-way information systems. □

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**Published by TELEPHONY PUBLISHING CORP., 55 E. Jackson, Chicago, IL 60604 Telephone 312/922-2435; TWX 910 221 1058**

**European Bureau, 136 Broomfield Rd., Chelmsford, Essex CM1 1RN, England; Telephone Chelmsford (0245) 58257; Telex 995801 GLOTLX-G.**

TELEPHONY (ISSN 0040-2656/83-0+$1.50) is published weekly (except twice weekly during the second week of August and three times during the month of December) by Telephony Publishing Corp. Officers of Telephony Publishing Corp. are Dan S. Fargo, President; Leo Anderson, Executive Vice President; Del Myers, Ed Robinson and Robert Wehofer, Vice Presidents. Postmaster: Please send form 3579 to Subscription Dept., TELEPHONY, 55 E. Jackson Blvd., Chicago, IL 60604. Second class postage paid at Chicago, Ill., and at additional mailing offices. Single copies (payable in advance) U.S. $3.00 ea., issues over 2 years old $3.50 ea. Outside U.S. add $1.00 ea. Subscriptions: $29 one year. Outside U.S. add $20 per year. Subscription rates apply to employes of operating telephone companies; telephone consultants; contractors; interconnect companies; specialized common carriers; military government associations; private communications users; schools; libraries. All others $35 one year. Outside U.S. add $20 per year. Change of address: include old address as well as new address. Attach issue label if possible. Allow 4 weeks for change to become effective. Copyright 1983 by Telephony Publishing Corp. Permission to photocopy for internal or personal use or the internal or personal use of specific clients is granted by Telephony Publishing Corp. for libraries and other users registered with the Copyright Clearance Center (CCC) provided that the fee of $1.50 per page is paid directly to CCC, 21 Congress St., Salem, MA 01970. Special requests should be addressed to Telephony Publishing Corp.

# Maritime communications sail into bright international seas

OLOF LUNDBERG

THE MARITIME community has long recognized the need for improved, reliable, high quality telecommunications offering the same level of service that a land-based subscriber has come to take for granted. Although much improved in recent years, conventional maritime communications still suffer from ionospheric disturbances, crowded air waves and other problems which have led to delays of hours, if not days, before a call can be completed. Not only have these delays been a handicap to improving the efficiency of shipping generally, they have sometimes been disastrous in emergencies.

To overcome this situation, the International Maritime Satellite Organization (INMARSAT) was established as a result of an international conference convened by the International Maritime Organization, an agency of the United Nations. Twenty-eight countries signed the convention; there are now 39 member countries (Figure 1). Tunisia was the latest country to join.

INMARSAT has a three-tier organizational structure: an assembly of parties (or states); a council of signatories who have invested in the organization; and a directorate based in London. Where we differ from our sister organization, INTELSAT (International Telecommunications Satellite Organization), is that we have several East European member countries, notably the Soviet Union, Poland and Bulgaria.

## Components

The INMARSAT system has three major components, none of which is meaningful without the others. These are the satellites, which we now lease from the MARISAT joint venture, the European Space Agency and INTELSAT; the coast earth stations, which are operated by signatories and which give access to national and international telecommunications networks; and the ship earth stations.

INMARSAT was formed in July 1979 and has been operational since February 1982. In the first year of operation, the number of users of the system increased by about 60%—at a time when international shipping was suffering its worst economic crisis since the 1930s. We now have slightly fewer than 1800 users, including oil tankers, offshore drilling rigs, cargo and container vessels, passenger liners, cable laying ships, seismic survey vessels, yachts, tugs and ice breakers.

Although our first year's growth rate was impressive (it was actually better than we had expected), the economics of providing satellite communications for mobile users is marginal, demanding a cooperative effort on the part of the international community. Just as the shipping industry has become an international business, the mobile user requires an international system. National or regional satellite systems for such a small dispersed market do not make sense, either in terms of logistics or finance.

However, INMARSAT does not intend to be perceived as having a monopoly nor shall we act as if we do. We recognize that we can only justify our existence on the excellence of the services we provide and on our ability to meet users' requirements. We must be guided by those requirements, or rather by an enlightened and imaginative matching of technology with users' needs. To that end, it is essential that users make their requirements known.

The INMARSAT satellite system is somewhat different from most other satellite organizations which provide a fixed or DBS (direct broadcast satellite) service. We interface directly to the end user's telephone set on the mobile side of the satellite. We and our signatories extend terrestrial telecommunications networks to the oceans of the world. When someone on board a ship picks up the telephone, he is using the ultimate in cordless telephones.

The INMARSAT system is also characterized by a very large number of earth stations. Because ours are highly volatile mobile end users, we are faced with a major technical and administrative challenge. The traffic volume per terminal is generally small, often only a few minutes per day. The small mobile antenna necessitates high satellite power and thus creates a high production cost per circuit.

To place or receive a call, the user has a ship earth station. The only ship earth station type-approved so far by INMARSAT is known as the Standard A. The ship earth station can be purchased from and installed by more than a dozen suppliers around the world. It consists of above and below deck equipment. Below deck are the telephone, telex, data and facsimile machines connected to the above deck unit, which consists of a parabolic antenna ranging from 0.8 to 1.2 m (meter) in diameter. A sophisticated stabilization system, which accounts for its price being higher than its terrestrial counterparts, keeps the dish constantly tracking the satellite despite the ship's course and movement. Once the call is dialed, the signal is transmitted from the satellite to the coast earth station, where it is switched to national and international networks.

## Technical developments

For now and probably until the early 1990s, the Standard A, which is an analog terminal, is likely to remain the all-purpose workhorse of the INMARSAT system.

Development work is proceeding, however, on other possible standards to meet the needs of high and low volume users. These new standards could reach the market at approximately the same time as INMARSAT's second generation satellite system does in 1988.

Our next generation satellites will

*Olof Lundberg* is Director General of the International Maritime Satellite Organization (INMARSAT). This article was adapted from a speech he delivered at the Satellite Summit Conference, held May 17-19 in London.

be required after 1988. The request for proposals (RFPs) were recently issued. They call for satellites with three to four times the present capacity. The planning and procurement of our second generation satellite system is the organization's major priority.

The development and use of satellites have truly brought about a revolution in maritime communications, so much so that the present Morse and complex manual systems will be phased out over the next decade. They aleady are being replaced by a simple, automatic communications system, which anyone can easily use. Such systems can also make a significant contribution to the safety of life and property at sea, giving new facilities to shore-based rescue authorities which will, for example, be able to make group calls to ships in the vicinity of an emergency.

In the longer term, a driving force in the development of new terminals will be the requirements of the future global maritime distress and safety system (FGMDSS) which is being specified by INMARSAT to help protect life and property at sea. As a result of the FGMDSS, we expect that most vessels on the high seas will use INMARSAT services in the 1990s.

| | | |
|---|---|---|
| USA | Communications Satellite Corporation (COMSAT) | 23.36370 |
| USSR* | Morsviazsputnik | 14.09217 |
| UNITED KINGDOM | British Telecom | 9.89134 |
| NORWAY | Norwegian Telecommunications Administration | 7.87821 |
| JAPAN | Kokusai Denshin Denwa Co., Ltd. | 6.99915 |
| ITALY | Ministero delle Poste e Telecomunicazioni | 3.35524 |
| FRANCE | Direction Generale des Telecommunications | 2.88553 |
| GERMANY, FEDERAL REPUBLIC OF | Bundesministerium fur das Post und Fernmeldewesen | 2.88553 |
| GREECE | Hellenic Telecommunications Organization (OTE) | 2.88553 |
| NETHERLANDS | Netherlands PTT Administration | 2.88553 |
| CANADA | Teleglobe Canada | 2.61717 |
| KUWAIT | Ministry of Communications | 2.01315 |
| SPAIN | Compania Telefonica Nacional de Espana | 2.01315 |
| SWEDEN | Swedish Telecommunications Administration | 1.87898 |
| AUSTRALIA | Overseas Telecommunications Commission (OTC) | 1.67770 |
| BRAZIL | Empresa Brasileira de Telecomunicacoes S.A. (EMBRATEL) | 1.67770 |
| DENMARK | Post and Telegraph Administration | 1.67770 |
| INDIA | Overseas Communications Service | 1.67770 |
| POLAND | Office of Maritime Economy | 1.67770 |
| SINGAPORE | Telecommunication Authority of Singapore | 1.67770 |
| CHINA, PEOPLE's REPUBLIC OF | Beijing Marine Communications and Navigation Company | 1.23666 |
| ARGENTINA | Empresa Nacional de Telecomunicaciones (ENTEL) | 0.60395 |
| BELGIUM | Regie des Telegraphes et des Telephones | 0.60395 |
| FINLAND | General Directorate of Posts and Telecommunications of Finland | 0.60395 |
| NEW ZEALAND | Post Office Headquarters | 0.36277 |
| BULGARIA | Shipping Corporation | 0.27204 |
| PORTUGAL | Companhia Portuguesa Radio Marconi | 0.20610 |
| ALGERIA | Ministere des Postes et Telecommunications | 0.05000 |
| CHILE | Empresa Nacional de Telecomunicaciones S.A. (ENTEL-CHILE) | 0.05000 |
| EGYPT | Telecommunications Organization | 0.05000 |
| IRAQ | Republic of Iraq | 0.05000 |
| LIBERIA | Republic of Liberia | 0.05000 |
| OMAN | Sultanate of Oman | 0.05000 |
| PHILIPPINES | Philippine Communications Satellite Corporation (PHILCOMSAT) | 0.05000 |
| SRI LANKA | Overseas Telecommunication Service | 0.05000 |

* includes the initial investment share of Byelorussian and Ukrainian SSRs

**FIG. 1** *Signatories of INMARSAT and their percentage of investment shares.*

## Help in bad times

The INMARSAT system may also be used to bring relief in national disasters on land. Disaster relief agencies are able to use satellite terminals to restore communications in areas stricken by flood, fire or earthquake. Such use of INMARSAT terminals has been authorized.

In some areas where there are either no communications or only inadequate communications, some users or potential users may be tempted to use INMARSAT terminals. Where there is no economic alternative, this may seem to make sense, but it poses institutional difficulties for us. For one thing, it is outside the scope of INMARSAT's mandate to provide communications for fixed services. At an international level, this is within INTELSAT's purview, but INTELSAT does not have the facilities for such services at present and some of our members are anxious to be able to satisfy these requirements.

INMARSAT is required to operate on a commercial basis. Its signatories are increasingly responsive to user needs. Thus, if the institutional difficulties could be resolved satisfactorily, INMARSAT could, in the short term, support important international thin route traffic very quickly and at a relatively low cost to the user. However, this can only be a short term solution because our system is not designed to provide services of this nature on a permanent basis. Our prime duty is the provision of high quality services to the maritime mobile community. At best, we can handle thin route traffic on an *ad hoc* basis as a stop-gap measure.

Although INMARSAT was created to serve maritime requirements, other possible applications were foreseen at the international conference which conceived the organization. Some of the applications, the feasibility of which we are exploring, relate to navigation via satellite and aeronautical communications.

During the last 30 years, a large number of radio navigation systems have been developed. Decca, Loran-A, Loran-C, Omega and The Tsikada and Transit satellite systems have been used by various sectors of the marine industry for general navigation purposes. There is, however, no single system which satisfies the needs of all mariners for all purposes.

We continue to observe the growing interest in a navigational system under international control. Indeed, the point was raised at the United Nations conference on the peaceful uses of outer space, or Unispace 82, held in Vienna in August 1982.

Unispace 82 concluded that "a long term answer to the needs of the many actual and potential user countries needs to be devised." It further observed that "a single worldwide system seems very attractive since it would ensure compatibility and yet require a much lower investment from interested countries because space segment costs could be shared."

INMARSAT is examining such a scenario. To this end, the INMARSAT research and development program includes study of the possible use of non-geostationary satellites to augment coverage for INMARSAT services in polar regions not covered by INMARSAT's geostationary satellites.

Although INMARSAT is interested in providing a navigational capability, we have made no commitment to do so. Since money does not grow on trees, even if we could provide such a capability, who would pay for it? Or, equally important, how could such a

*Continued on page 73*

service be provided at low cost?

If a polar-orbiting satellite system were to complement the existing geostationary system, it might conceivably meet three requirements: a worldwide navigational capability, if a navigation satellite system under international control is deemed desirable and viable; a total global satellite visibility for a worldwide EPIRB (emergency position-indicating radio beacon) system also usable by aircraft ELTs (emergency locator transmitters); and low volume L-band communications for ships and aircraft in the polar regions. Above all, it must be cost effective.

The INMARSAT council recently approved an amendment to INMARSAT's draft request for proposals for its second generation satellite system which will provide an aeronautical capability. This would principally involve an extension of the upper end of the L-band bandwidth by about 1 MHz (megahertz), with a slight shift of C-band feeder link frequencies. The decision follwed a recent expression of interest in such a facility by the International Civil Aviation Organization. The fact that our second generation satellites will incorporate a small part of the aeronautical L-band does not mean we are committed to providing an aeronautical service, nor that the aeronautical community is committed to using it. At this stage, it merely means that we could provide it, subject to detailed consultations between INMARSAT and the aeronautical community.

### Uses

Aircraft could use satellites for air-to-ground data links for air traffic control, for transmission of airline operational data and weather reports, and for passenger telex services. Among the factors which favor cooperation between the maritime and aeronautical communities are the adjacency of frequency bands which provides the opportunity to use common satellite facilities and similar terminals; the coverage of INMARSAT satellites of all major routes; and the prospect of mutually beneficial economies of operation.

Indeed, these points prompted the 1975-76 international conference to recommend "the study of the use by INMARSAT of multi-purpose satellites providing both a maritime mobile and an aeronautical mobile capability." What we are proposing, therefore, to the aeronautical community is a low cost, low risk, low commitment start-up system in which they would share space and possibly ground segment facilities with maritime users until dedicated aeronautical facilities could be justified.

Nevertheless, there does seem to be growing enthusiasm and interest in such a scheme. U.S. Federal Aviation Administrator Lynn Helms recently said that "time has come for the aviation community to make an objective, dispassionate and systematic assessment of the value of space technology applications to civil aviation." He noted that "the civil aviation community has failed to examine aviation's problems, needs and technical solutions involving space technology in a well considered, systematic manner."

While cooperation between the two user groups makes tremendously good sense, all solutions should be driven by user requirements. We continue to have discussions with aeronautical industry organizations and they are actively studying the use of satellites to solve some of aviation's communications problems.

### Other possibilities

As for land mobile, INMARSAT continues to be asked whether we will eventually be able to provide such service. INMARSAT is a reasonable possibility if a thin-route international land mobile system is required. It is not a system which could be used for high density applications; terrestrial systems should be used in those, mostly urban areas.

An immediate challenge for INMARSAT is to reach that state of felicity where red ink is balanced by black ink. The formation of INMARSAT amounted to an act of faith by governments and by signatories. It is now fair to characterize INMARSAT as a going concern. It is doing better than initially expected and, as a consequence, that act of faith is being rewarded. Thus, we have moved forward the date when we expect to break even.

Although we have not yet reached that state of felicity, we are getting close—close enough that it would not be premature to view INMARSAT as a successful model of international cooperation established to meet a real need and doing exactly that. INMARSAT can also represent a challenge to governments, to other international organizations and to opinion leaders to think more in terms of what can be achieved through consensus and cooperation.

The challenge is to think international. □


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# telephony

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Avalanche of access charge filings buries the FCC, p.14
MCI Communications launches electronic mail service, p.22

**Cover:** Which side are you on in the access charge debate? Champions of each side argue their points and let the chips fall where they may, beginning on p.28

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**Published by TELEPHONY PUBLISHING CORP., 55 E. Jackson, Chicago, IL 60604 Telephone 312/922-2435; TWX 910 221 1058**

**European Bureau, 136 Broomfield Rd., Chelmsford, Essex CM1 1RN, England; Telephone Chelmsford (0245) 58257; Telex 995801 GLOTLX-G.**

**TELEPHONY (ISSN 0040-2656/83-0+$1.50)** is published weekly (except twice weekly during the second week of August and three times during the month of December) by Telephony Publishing Corp. Officers of Telephony Publishing Corp. are Dan S. Fargo, President; Leo Anderson, Executive Vice President; Del Myers, Ed Robinson and Robert Wehofer, Vice Presidents. Postmaster: Please send form 3579 to Subscription Dept., TELEPHONY, 55 E. Jackson Blvd., Chicago, IL 60604. Second class postage paid at Chicago, Ill., and at additional mailing offices. Single copies (payable in advance) U.S. $3.00 ea., issues over 2 years old $3.50 ea. Outside U.S. add $1.00 ea. Subscriptions: $29 one year. Outside U.S. add $20 per year. Subscription rates apply to employes of operating telephone companies; telephone consultants; contractors; interconnect companies; specialized common carriers; military government associations; private communications users; schools; libraries. All others $35 one year. Outside U.S. add $20 per year. Change of address: include old address as well as new address. Attach issue label if possible. Allow 4 weeks for change to become effective. Copyright 1983 by Telephony Publishing Corp. Permission to photocopy for internal or personal use or the internal or personal use of specific clients is granted by Telephony Publishing Corp. for libraries and other users registered with the Copyright Clearance Center (CCC) provided that the fee of $1.50 per page is paid directly to CCC, 21 Congress St., Salem, MA 01970. Special requests should be addressed to Telephony Publishing Corp.

# Access charges:

## Some see conflict with universal service

*The debate over the effects of the FCC's recent access charge order and its threat to universal telephone service continues. Several bills pending in Congress would curb or modify the FCC's decision, before the Jan. 1, 1984, divestiture of the Bell System. The National Governors' Assn. has established a task force on Universal Telephone Service to review this sensitive issue. On Sept. 7, the task force met in Chicago for a fact gathering hearing, which included testimony from members of the telecom industry. The task force's recommendations are expected later this month. These articles, which present opposing viewpoints, are adapted from presentations made before the task force.*

BENNET R. MILLER

MY OPINIONS concerning the preservation of universal telephone service represent the position of Tri-County Telephone Co., New Richmond, Ind., which serves 2500 customer access lines in four exchanges, as well as the views of the Organization for the Protection and Advancement of Small Telephone Companies (OPASTCO).

For many years, as the industry moved inexorably toward a full competitive environment, representatives of small telephone companies have expressed concern about the impact of the changes in the telephone industry on subscribers in rural America. The goals of preserving universal telephone service and moving toward a competitive telecommunications industry often are in conflict. Only Congress can resolve these issues and enact sufficient protections to assure continued availability of telephone service.

I do not ask that the clock be turned back. Technological advances, the divestiture of American Telephone & Telegraph Co. (AT&T), and Federal Communications Commission (FCC) and court decisions have made it clear that the telecommunications industry of tomorrow will develop in a competitive marketplace and will not be characterized by monopoly provision of any services.

People in rural America also want to be part of this technological revolution. Small Independent telcos also want to participate in the Information Age, but are concerned that telephone service may be priced beyond the reach of many subscribers if modifications are not made to recent FCC decisions. Subscribers in rural America, indeed all Americans, should continue to have high quality telephone service at rates which are affordable.

Maintaining universal service at reasonable rates as the industry becomes fully competitive is no easy task. Congress has been struggling with these competing goals for more than 7 years. The issues are now

*Continued on page 32*

*Bennet R. Miller* is President of Tri-County Telephone Co., New Richmond, Ind. He also is President of the Independent Telephone Pioneer Assn. (ITPA). This article has been adapted from a speech Miller presented to the National Governors' Assn. Task Force on Universal Service, Sept. 7 in Chicago.

## Access charge conundrum

THE VEXATIOUS issue of access charges is currently preoccupying the telecommunications industry and many Congressmen. This article presents views from both sides.

The first part of the article, which begins on this page, is by President Bennet R. Miller of Tri-County Telephone Co., New Richmond, Ind., and an active member of both the Organization for the Protection and Advancement of Small Telephone Companies (OPASTCO) and the U.S. Independent Telephone Assn. (USITA). Miller proposes to use funds contributed equitably by all telecommunications carriers to cushion the effects of competition on rural telephone subscribers and, thus, to preserve universal service. Miller suggests that Congress should pass legislation to effect this goal and defines five points which such legislation should include.

The second part of the article, which begins on the following page, is by Executive Vice President Carl E. Horn of Illinois Bell Telephone Co. Horn argues that competition will reduce some costs, that phone service will still be relatively inexpensive, that the separations procedure used to cushion high cost customers has had disadvantages of its own and, finally, that the solution to the problems involved in the transition to a competitive market will not necessarily be resolved by renewed government intervention in the market.

Both cases are closely argued and helpful to readers who want to review the issue in detail.

Who is the distinguished gentleman gracing this week's cover?

The cover art for this issue comes from a slide show put together by the Public Relations Committee of USITA to help telcos explain the USITA position on access charges to the public. The slide show centers around an analogy. There is an imaginary island which lacks telephone service. After smoke signals and drums fail to provide the desired quality of communication with another imaginary island, residents of

# pros and cons

## Others see little threat to service

CARL E. HORN

THERE are two principal reasons why local telephone service will cost customers more next year than it has this year:

- Costs for providing local service will continue to increase, including expenses for labor, depreciation, taxes and postage; and
- The Federal Communications Commission (FCC) will require all customers to pay at least a $2 per month fee for access to the interstate telephone network.

Technically, only the first reason necessitates higher customer costs. The second reason reflects the FCC's decision to have telephone companies collect some of the subsidy that flows from long distance calls to local service on a flat fee basis—and less in the cost of the call. But many customers will think of this change as a rate increase for local service, even though long distance rates are expected to go down. This raises a key question.

Will these rate increases cause subscribers to drop off the telephone network? Or, to restate the question in other words, do these changes pose a threat to universal telephone service?

In general, the answer to this key question is: "No."

There are a number of reasons for this answer. Among the more important reasons are that:

- There are many service options from which customers can choose, in order to reduce their total spending for telephone service, without dropping off the network.
- Telephone rates have increased in the past 10 years by about 60%, but the number of people with telephone service has never been greater. The 60% national average increase compares with more than 100% increase in the consumer price index (CPI) and only a 40% increase in telephone rates in Illinois.
- Telephone service is, and will remain, relatively inexpensive compared to many other goods and services, such as electricity, food and clothing.

Of course, the impact of telephone rate increases will vary in the future as it has in the past. Some states will experience increases faster than others. But that is true of many other things, too; the rate increase impact in any particular area is a consequence of the economic characteristics of the area. Is it costly to do business there? Is the economy growing rapidly? Have costs been held down artificially in the past?

Clearly, there are many changes occurring in telecommunications.

**Technology.** Technological capabilities are changing rapidly. New telephone equipment, such as switchboards and telephones, is almost all solid-state electronic gear with extensive capability for software programing. Telephone companies no longer have a monopoly to provide that equipment.

Technological changes are also remaking long distance telecommunications. Satellites, fiber optics and electronic switching, including distributed processors, have persuaded regulatory agencies and federal courts that competition is better than monopoly for long distance communications. Technological change is certain to continue apace.

**Competition.** Once the natural monopoly barriers were set aside—ultimately by the courts in all cases—rapid changes swept through the telecommunications industry. In general, the judgment of Americans is that competition among suppliers is better than regulated monopoly for meeting

*Continued on page 32*

*Carl E. Horn* is Executive Vice President of Illinois Bell Telephone Co., Chicago. This article is adapted from a presentation Horn made to the National Governors' Assn. Task Force on Universal Service, Sept. 7 in Chicago.

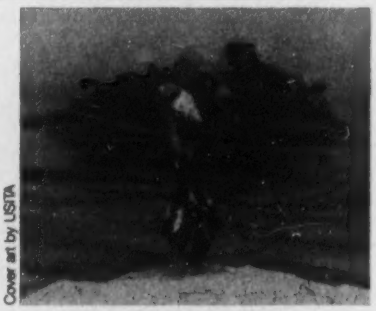
the first island create long distance telephone service, which leads to a demand for local telephone service. Eventually, both types of service are provided, but local service is more expensive to provide.

In order to keep the price of local service low enough for users to afford, revenues from overpriced long distance service are diverted to underpriced local service. A competitor emerges who offers long distance service at a lower price because he is not contributing to the pool of funds used to help keep local service on the island underpriced.

This causes a familiar problem. Finally, the island's leader decides upon a solution: the island society needs an access charge to make up for lost long distance revenues.

Then the show shifts to a discussion of the Federal Communications Commission's access charge plan and other related issues currently troubling the industry.

The 14-minute show includes more than 80 35-millimeter slides packaged in a carousel and an audio tape in standard cassette form. USITA also provides a support kit. The kit includes a speech, a comprehensive bill insert on access charges, a sample question and answer booklet for distribution to audiences, a sample edition of PhoneFacts '83, a news release on the user's first public presentation, a typed script for the complete slide show and guidelines on how to use the slide show, the kit and the equipment.



Cover art by USITA

*An informed resident of an imaginary island grappling with the access charge issue pauses to reflect on economic realities in the USITA film. The transition to competition clearly is no easier for him than it is for people in the real telephone industry.*

For additional information about the slide show, contact Becky SuPrise at USITA, 1801 K St., N.W., Suite 1201, Washington, D.C. 20006. □

*Continued from page 28*
clearly focused; the solutions are at hand. We cannot afford to wait and see how many subscribers are left without telephone service when we have the ability to prevent such a consequence now.

Legislation to preserve universal telephone service should address several crucial principles:

- All providers of telecommunications services, including bypassers of local facilities, should contribute equitably to the costs of providing local telephone service.
- A Universal Service Fund (USF) to deal adequately with telephone service in high cost areas must be developed.
- Consistent and uniform regulatory policies between federal and state jurisdictions should be implemented.
- End users should not pay directly for the costs of the local telephone lines.
- Toll connecting links for which costs are significantly higher than the national average should be compensated for with funds from the USF.

Each of these principles will be addressed here.

All providers of telecommunications services should contribute fairly to the costs of providing universal service. Providers of telecom services which bypass the local distribution facilities of exchange carriers also should share the cost of these local facilities. Although competition has increased and alternative technologies have been developed, there has not been a stampede of carriers serving high cost rural areas or residential subscribers. Competitors have entered markets which are profitable and have not chosen to serve the high cost and lower density markets. Yet all telecom service providers benefit from the universality of telephone service; all providers benefit from using existing facilities as a back-up or to expand their own networks. Their profitability is increased by universally available phone service. Therefore, they should all contribute to the cost of preserving these universal local facilities.

Legislation should ensure that USF is created which will adequately protect exchange carriers that serve high cost areas. Exchange carriers for which costs exceed the national average by more than 110% should be eligible to receive funds from the USF. These eligible carriers also should recover all of their costs from the USF which exceed the national average in order to ensure that they are able to continue providing service in high cost areas and that their customers are able to afford telephone service.

As competition in telecommunications has been sanctioned by the federal courts and the FCC in recent years, there has been increasing conflict between the federal and state regulatory bodies. Consistent regulatory policy is essential to the continued financial viability of telephone companies. As Congress establishes clear goals for national telecommunications policy, it should act to ensure consistent regulatory policy at the federal and state levels. As telcos try to provide high quality service to customers and take advantage of new technology to reduce costs, they suffer from constant confrontations between federal and state regulatory policies. Congress can eliminate these needless and costly regulatory battles by setting a clear national policy direction. The economic health of small Independent telcos, and thus their ability to serve customers, depends on it.

The FCC's decision in Docket 78-72 would transfer, over a transitional period, most costs of the customer's access line to the interstate telephone network directly to subscribers or end users at a flat rate. This would be true whether or not these customers ever make a long distance call. The essential rationale for the FCC's decision was to prevent the uneconomic bypass of local facilities by heavy users of telecommunications services who pay a disproportionate share of the fixed cost of local facilities through usage based rates. The FCC went too far; by attempting to cure one problem, it has created another.

The transfer of all fixed costs to end users places an excessive burden on residential customers, particularly in high cost rural areas. If these costs are charged directly to customers, many will not be able to continue their basic telephone service. Furthermore, if end users must pay all local loop costs on a flat rate basis, there is no incentive for exchange carriers to make investments in modern facilities. Interexchange carriers depend on these facilities and benefit from continued upgrading and introduction of new technology.

Congress should change this portion of the FCC decision and modify end user charges.

In low density rural areas, the costs of providing service between the local telco's central office and the toll network are exceedingly high. These toll connecting links—or Class 4 to Class 5 links—constitute the portion of the telephone network where there is the greatest cost variance. If exchange carriers are forced to charge interexchange carriers directly for the costs of these toll connecting links, the pressure to deaverage toll rates for calls into and out of rural areas will be severe. The USF should provide a contribution to the cost of these high cost toll connecting links in order to prevent excessively high toll rates for rural areas.

Congress must act now to preserve universal telephone service. □

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*Continued from page 29*
their needs. The gains made by competitors in telephone equipment and long distance service bear out that judgment.

All the costs assigned to long distance service have been paid for with each call. But a large portion of the price of each call does not depend upon characteristics of the call itself, such as how many minutes the call lasts, how far it goes, or whether or not the call is completed. Those calls have a large margin of subsidy, due to uneconomic cost allocations, that are built into the rate structure. It is that large margin of uneconomic costs for regulated carriers which has brought competitors into the marketplace, facilitated by technology and judicial orders.

The way long distance calls are priced will have to change. The price will certainly be reduced when the FCC's access charges are implemented.

**Telephone ratemaking.** Telephone rates have been—and still are —set in regulatory proceedings. That process takes a great deal of time and depends on prior rate cases which brought rates, in both structure and level, to where they are today. Those proceedings also are subject to a great deal of public and political attention. Telephone ratemaking, which has been carried on in a monopoly setting for more than 50 years, has not changed nearly as quickly as technological and competitive circumstances have. This is one of the principal causes of the current debates between federal and state regulators, and among regulators and

*Continued on page 34*

## Table 1
### 1982 interstate-intrastate separations
**Selected states ($ million)**

| Net gainers | | Net losers | |
|---|---|---|---|
| Arizona | $ 64 | Illinois | $ 73 |
| California | 280 | Massachusetts | 78 |
| Florida | 263 | New Jersey | 197 |
| Montana | 26 | Pennsylvania | 153 |

legislators, over access charges, depreciation and federal pre-emption in these areas.

Telephone ratemaking will have to change more rapidly in order to reflect cost and economic performance criteria. The comfortable customs of implicit subsidies among services—from interstate to intrastate; from toll to local; and from business to residence—will have to change.

**Ratemaking subsidies.** In 1982, about $10 billion in revenue requirements (customer payments) were distributed by the separations process. That process was a hallmark of historical natural monopoly regulation, but cannot continue in the emerging competitive era.

It will be difficult to move away from the separations subsidy because that subsidy was built up very unevenly through the years. For instance, consider some of the dollar flows that result from the interstate-intrastate separations process in 1982, as shown in Table 1.

## Table 2
### 1984 separations, with freeze
**Selected states ($ million-estimated)**

| Net gainers | | Net losers | |
|---|---|---|---|
| Arizona | $ 82 | Illinois | $138 |
| California | 438 | Massachusetts | 102 |
| Florida | 320 | New Jersey | 262 |
| Montana | 27 | Pennsylvania | 194 |

## Table 3
### 1984 separations, under access charge order
**Selected states ($ million-estimated)**

| Net gainers | | Net losers | |
|---|---|---|---|
| Arizona | $ 88 | Illinois | $103 |
| California | 210 | Massachusetts | 71 |
| Florida | 288 | New Jersey | 167 |
| Montana | 24 | Pennsylvania | 190 |

## Table 4
### 1984 separations, if USF is fully employed
**Selected states ($ million-estimated)**

| Net gainers | | Net losers | |
|---|---|---|---|
| Arizona | $ 1 | Illinois | $42 |
| California | -57 | Massachusetts | 26 |
| Florida | 182 | New Jersey | 50 |
| Montana | 9 | Pennsylvania | 38 |

In general, the net payers of the subsidies are industrial, heavily populated states in the Midwest and Northeast.

The separations system generally is regarded as having gone too far in the redistribution of revenues among the states. A joint board composed of state and FCC commissioners froze one element of the separations formula effective early in 1982. But, even with that freeze, the net flow of dollars from the old industrial states of the North would have continued in 1984 (Table 2).

However, under the FCC's access charge order, the situation in 1984 would be somewhat better for the Northern industrial states (Table 3).

The separations process is not well correlated with either economic cost causation or with emerging competitive realities. In addition, many states created subsidies through the years by raising state toll rates above economic cost and keeping local exchange rates well below economic cost. It is understandable that any explicit adjustment of such a well entrenched set of implicit subsidies will be difficult.

**'. . . the impact of telephone rate increases will vary in the future . . . .'**

**FCC access charges (Docket No. 78-72).** The FCC has looked at the issue of subsidies in the context of developing long distance competition since early 1978, and as early as 1980 proposed one method of dealing with them. The most recent FCC order on this subject requires a flat $2 per month charge per residential customer to recoup some portion of the heavy subsidy now built into every long distance call. The balance of the access charges will be levied on the interexchange carriers and in 1984, with the end user charges, will match the amount of revenues that would have been generated by the separations process.

By 1986, however, the separations process itself will begin to change so that the subsidy flows are narrower in the future. The FCC has also sought to temper the change by endorsing the joint board formula for a Universal

*Continued on page 36*

Service Fund (USF) which will help high-cost states keep local rates lower than they would be otherwise. If that high-cost USF factor were fully employed in 1984, the flows for selected states would be like those shown in Table 4.

**Avoiding bypass.** The FCC's access charges order puts some of the access cost directly on customers for the first time. It has become apparent to the FCC that the subsidy built into current long distance rates provides incentives which are contrary to the public interest in maintaining a local switched network. That is, in the first instance, the subsidy due to uneconomic cost allocations stimulated competition. And now, in a telecommunications world about to have all the long distance carriers, such as AT&T, MCI, and Sprint, competing on an equal footing, the continuation of that subsidy pricing would stimulate those carriers to bypass the local switched network.

Competitors are drawn to markets where entry is relatively free, as the long distance market now is, and where profits can be expected because prices are well above economic cost. The fact that MCI made 47% return on equity in 1982, contrasted with AT&T's 12%, amply demonstrates the point. It is especially true that selective competition for high density routes has a particular impact on carriers which must provide service everywhere.

When all competitors are required to pay high, uneconomic usage sensitive access rates, those competitors will have an incentive to bypass the local switched network. The expectation is that the announced policy of gradually reducing those charges in the coming years will deter significant bypass.

**'Competitors are drawn to markets where entry is relatively free . . .'**

### Legislative proposals

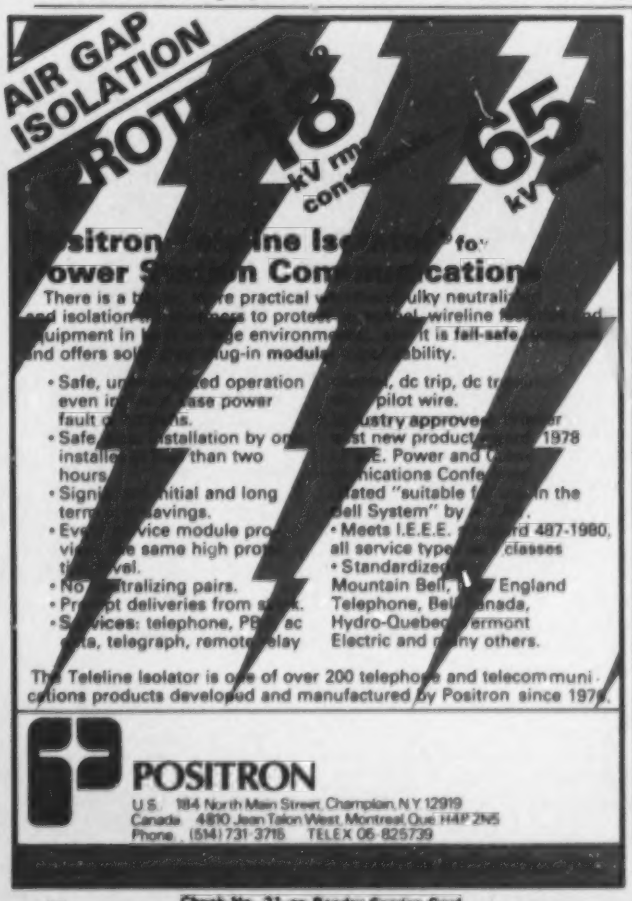
Because of concern that the flat rate and user access charges may cause a significant reduction in telephone subscribers, Congressional attention to this subject has developed. The bill proposed by Sen. Robert Packwood (R., Ore.) would have essentially doubled the continued subsidy which the joint board has established.

There are many other bills before Congress, each of which depends upon different assumptions about the very complex and rapidly changing world of telecommunications. Some of the bills are not specific enough to calculate the economic effects and permit judgments on how those proposals will benefit or handicap particular states and particular customers.

There is no doubt that the telecommunications marketplace is undergoing significant changes. It also is true that the final ramifications of these changes are not at all clear.

However, the principal stimuli to the changes are technology, competition and reduced regulatory involvement. Those forces all work to the advantage of customers in a free market system.

At this time, it is uncertain that a new form of administrative involvement—an act of Congress—will be able to better assist the adjustment of telecommunications services to market forces in the future. □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